THE GEOLOGY OF LIMESTONE MOUNTAIN AND SHERMAN HILL IN HOUGHTON COUNTY, MICHIGAN[1]

E. C. CASE AND W. I. ROBINSON
University of Michigan

Limestone Mountain and Sherman Hill consist of three small residual masses of dolomite in southeastern Houghton County, Michigan. The first is partly divided and is locally known as Big and Little Limestone. These paleozoic outliers have been the subject of some previous study, but the visits of the geologists have been brief and the work incomplete. During the summer of 1913 the authors spent six weeks in the region in an attempt to determine the exact age and structure of the beds. The result of this work will be published in full by the Michigan Geological Survey, but the results obtained contain so much of interest that a brief preliminary report seems desirable.

Limestone Mountain lies half a mile east of the little station of Hazel on the Mass City branch of the Mineral Range Railroad and directly north of the track. Sherman Hill lies one and a half miles northeast of Limestone Mountain.

The fossils collected were determined by the junior author and finally submitted to Dr. E. O. Ulrich of the United States Geological Survey for revision and for the determination of the exact horizons. For this and for many helpful suggestions we desire at this point to express our thanks to Dr. Ulrich.

As finally determined, the stratigraphy of the beds is as follows:

Mid-Devonian.—All that is known of this horizon is a single mass of chert protruding from the talus on the southeastern slope of Big Limestone. It yielded four fossils:

Chonetes coronatus var.
Productella cf. *navicella* and *spinulicosta*
Spirifer aff. *pennatus*
Cystodictya cf. *hamiltonensis*

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These fossils are few in number but so characteristic that there can be no doubt of the presence of mid-Devonian rocks in or near Limestone Mountain.

Niagaran (Lockport).—A bed of very siliceous material was found on the south slope of Big Limestone. It could not be traced for any very great distance nor could any satisfactory determination of its position be made. No trace of a similar layer was found in any other outcrop. The fossils collected are:

Streptelasma spongaxis
Zaphrentis stokesi
Duncanella(?) sp.
Clorinda cf. *ventricosa*
Pentamerus sp.
Chonchidium decussatum(?)
Dalmanella cf. *elegantula*
Leperdita aff. *cylindrica*
Loxonema sp.

Middle to Upper Richmond.—Three fossils were found with the Niagaran material which show the presence of this horizon, but the bed could not be distinguished stratigraphically from the Niagaran.

Favosites asper
Columnaria alveolata
Plectorthis whitfieldi

Upper part of the Lower Richmond (Arnheim).—Near the southeastern corner of Big Limestone a thin layer of dolomite was found in the bottom of a deep gully. The layer was almost perpendicular, but as it was in the zone of broken talus we cannot be sure that it was in place.

Crinoid columnals
Coeloclema oweni
Mitoclema minutum
Mesotrypa patella
Bythopora striata
Rhynchotrema perlamellosa
Rhynchotrema capax
Conularia formosa
Primitia cincinnatiensis
Tetradella persulcata var.

Ceratopsis robusta
Calymene, a new species allied to *C. fayettensis* and *C. mamillatus.*
Conodont

Lower Richmond.—A bed about ten feet thick occurs at the top of Little Limestone and on the southeastern slope of Big Limestone which contains fossils of this age. The matrix is siliceous and the fossils are, as a rule, silicified.

Streptelasma rusticum(?)
Halysites gracilis
Iocrinus aff. *I. crassus*
Orbiculoidea (*?Schizotreta*), n. sp.
Rafinesquina, n. sp.
Leptaena unicostata, two new varieties
Plectambonites sp.
Plectorthis whitfieldi
Plectorthis kankakensis
Dalmanella aff. *rogata*
Dinorthis subquadrata
Hebertella, n. sp. aff. *H. insculpta, H. fausta*
Platystrophia sp.
Rhynchotrema capax

Galena (*Stewartville or Upper Galena*).—Sixty feet of heavy-bedded, cream-colored dolomite beneath the Lower Richmond on Little Limestone and at the top of Sherman Hill. The fossils occur near the top of the bed.

Cyrtolites cf, *retrorsus*
Liospira cf. *angustata*
Hormotoma(?) major
Lophospira minnesotensis
Maclurea crassa
Maclurina manitobensis
Maclurina cuneata
Trochonema umbilicatum
Fusispira subbrevis
Spiroceras sp.
Salpingostoma cf. *expansa Hall* and *buelli Whitfield*

Decorah (*Upper Blue*).—Below the last-described layer there is an old quarry on the eastern face of Little Limestone in a thin-bedded dolomite. The top layers are gray, the lower layers cream-colored with blotches of dark-red iron stain. Identical fossils

occur in both layers. A layer similar to the lower one, occurring on Sherman Hill, also carries Decorah fossils but shades up into the heavy dolomite without the intervening thin-bedded layer. The fossils found in the quarry are:

Crinoid columnals
Ceramophylla frondosa
Trematopora(?) primigenia
Halloporina crenulata
Arthrostylus sp.
Arthroclema sp.
Rhinidictya mutabilis
Rhinidictya fidelis(?)
Arthropora simplex
Escharopora subrecta
Escharopora confluens
Orthis tricenaria
Streptelasma profundum
Strophomena incurvata
Strophomena septata
Dalmanella rogata(?)
Hormotoma salteri canadensis
Aparchites sp.

Upper Black River (Upper Bluff).—At the extreme southwestern part of Big Limestone and eight feet above the sandstone there occurs a heavy-bedded, cream-colored, fossiliferous layer of dolomite. The beds above and below are completely barren, so far as we could determine.

Ctenodonta nasuta
Ctenodonta gibberula
Endodesma(?), n. sp.
Cyrtodonta billingsi
Cyrtodonta cf. *billingsi*, n. sp.
Cyrtodonta cf. *huronensis* and *subcarinata*
Cyrtodonta cf. *tenella*
Cyrtodonta, n. sp.
Vanuxemia aff. *niota Hall* and *subrotunda Ulrich*
Vanuxemia sp.

Potsdam (Jacobsville).—This is the lowest horizon in all the outliers and the only stratum which was observed at all three localities. It is a dull-brown, coarse, poorly cemented sandstone with

occasional streaks of a very fine conglomerate or a very coarse sandstone. On Big Limestone and Little Limestone the pebbles of the conglomerate are of quartz and about the size of a pea; near Sherman Hill the pebbles are larger and there is much chert and greenstone. No fossils were found in this layer. It has been referred by Lane to the Jacobsville Sandstone, probably of Potsdam age.

The hills are broken in a very intricate manner by minor faults of comparatively recent age. They are, in many cases at least, due to under cutting of the dolomite and to slumping. There are some major faults, notably the one between Big and Little Limestone, which involve the sandstone below. Unfortunately the data available do not serve to determine the age of the great Keweenawan fault; the most that we can say is that there was serious disturbance of the region at least as late as after mid-Devonian time.

The most important point brought out by this study is the demonstration that the paleozoic seas of the times mentioned above extended well into, if not over, the Northern Peninsula of Michigan, and our paleogeographic maps must be so far altered as to include that region within the areas of deposition. Dr. Ulrich has called attention to the similarity which exists between the Pentameroid forms of Big Limestone and those of the Far West indicating a broad extension of the Niagaran sea in that direction.

In conclusion the senior author desires to state that most of the field work and the determination of the fossils was done by the junior author and that to him in a large measure is due the credit for the recognition of the extension of the paleozoic sea over the Northern Peninsula of Michigan.